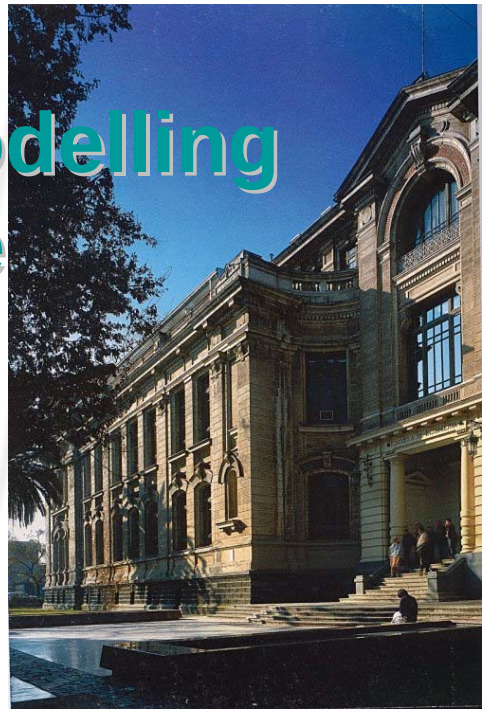
UNIVERSIDAD DE CHILE
Facultad de Ciencias
Físicas y Matemáticas

CMM

CNRS CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

Computing Optimal Equilibrium Strategies for Network Economies

Centre for Mathematical Modelling
Universidad de Chile



Eduardo Moreno
Postdoctoral Associate

Traffic Assignment Problem

Basics

- One of the most basic problems in transportation research
- Every individual travel along the shortest available path (considering congestion)
- Formulated as an equilibrium or fixed point problem
- Deterministic or stochastic models
- Stochastic models are more realistic but need more computation.
- Actual stochastic models are computational impractical for large networks.

Some software:

emme/2

Contram

DYNASMART
Powered by DTA Technology

Markovian Traffic Equilibrium

(Baillon, Cominetti, Math. Programming, to appear)

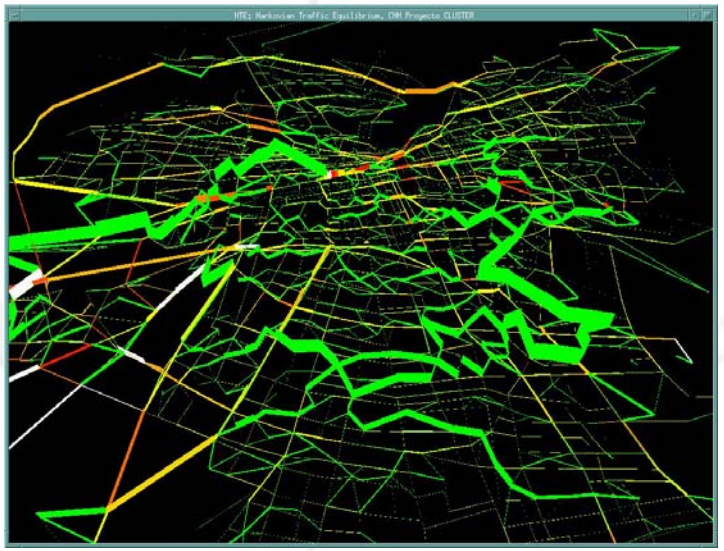
Details

- Based on discrete choice models but imbedded in a dynamic programming framework.
- At every intermediate node it selects the next street in a route to the destination, recursively.
- It take into account the variability of user preferences, stochastic congestion and uncertain travel times.
- It assume a randomness in the traffic of an arc, constructing a Markov chain.
- Model characterized with an unconstrained, strictly convex and coercive formulation, implying the existence and uniqueness of the solution.
- It avoids path enumeration, allowing to compute large networks.

Para ver esta película, debe disponer de QuickTime™ y de un descompresor YUV420 codec.

MTE: Practical Issues

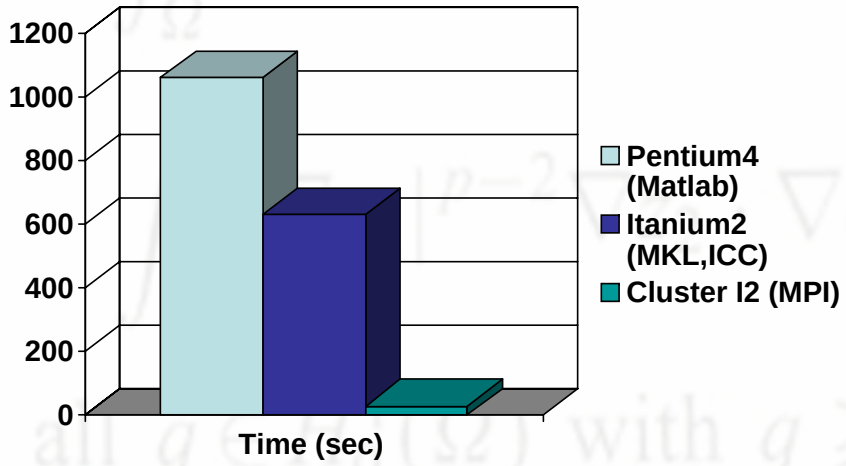
- Code originally written in Matlab
- Code rewritten in C using Intel MKL Libraries (VML, BLAS, PARDISO)
- Tuned for Intel Itanium 2 (but portable to other architectures)
- Parallelized using MPI Library



Santiago network (2159 destinations, 7587 streets)

Computation Time

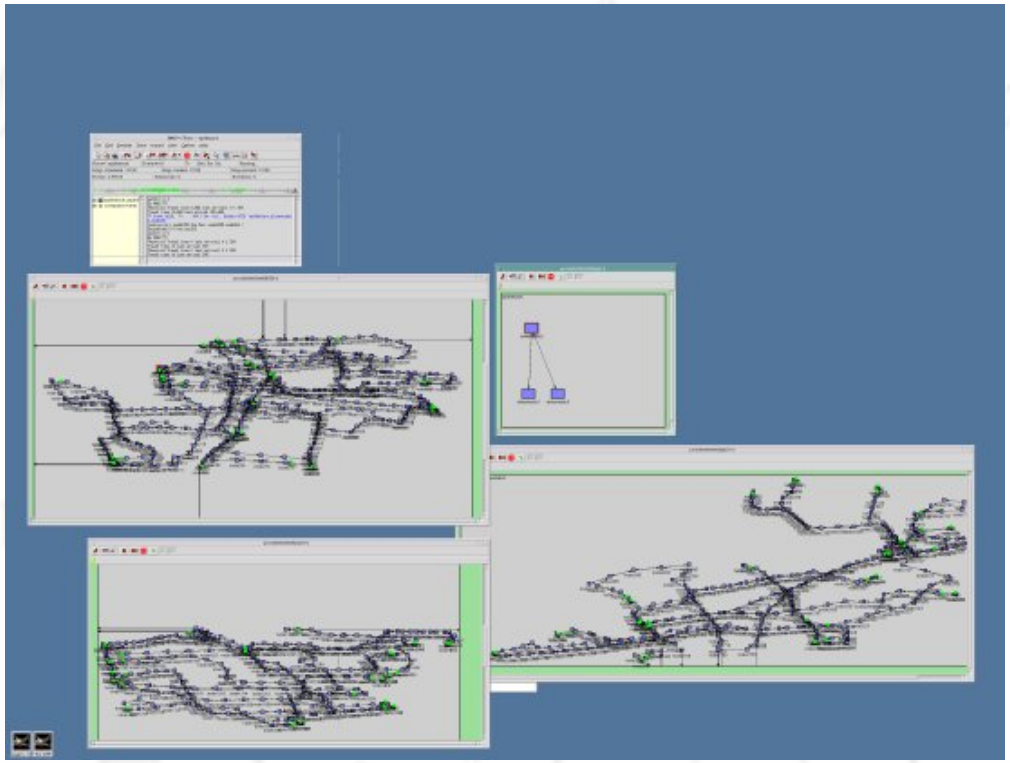
Chicago Network (546 destinations, 2176 streets)



Parallel Discrete Event Simulation: Public Transportation System

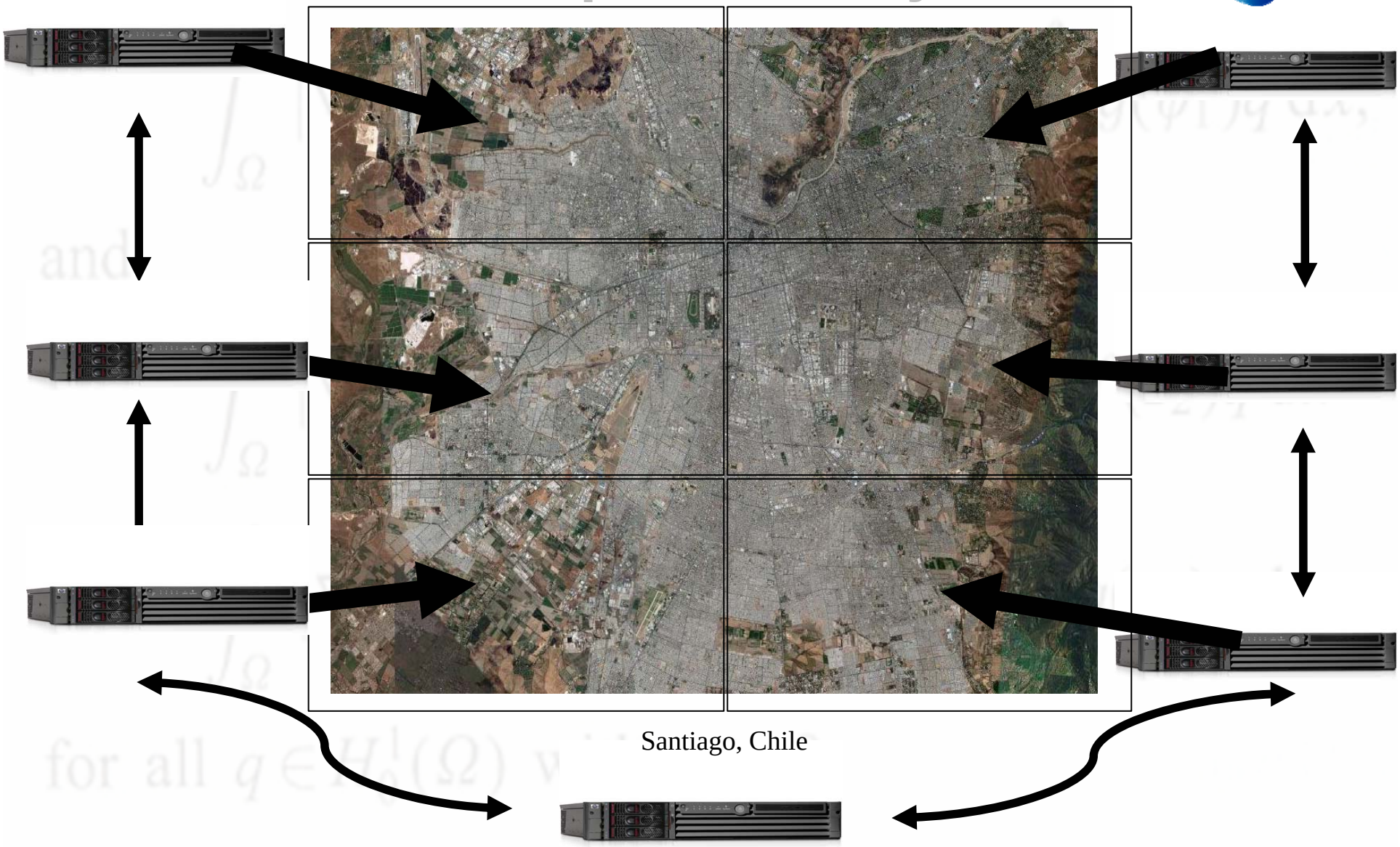
Keywords:

- Large transit networks
- Congestion
- Passenger perception
- Discrete event simulation
- Object oriented simulation
- Clustered databases
- MPI Communications



This model attempt to provide a simulated public transport scenario that can be use to improve the manager decisions respecting to public transportation policies. It analyzes a Wardrop equilibrium model for passenger assignment in general transit networks, including the effects of congestion over the passengers' choices.

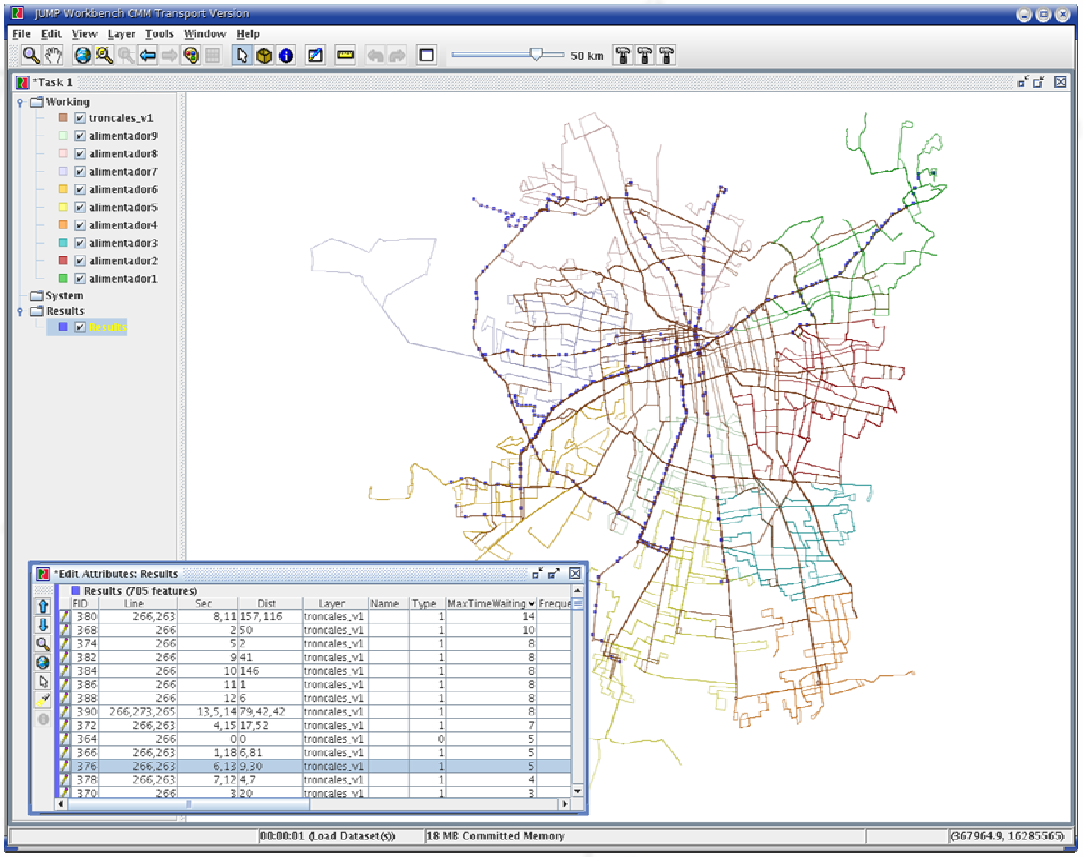
Parallel Discrete Event Simulation: Public Transportation System



Santiago, Chile

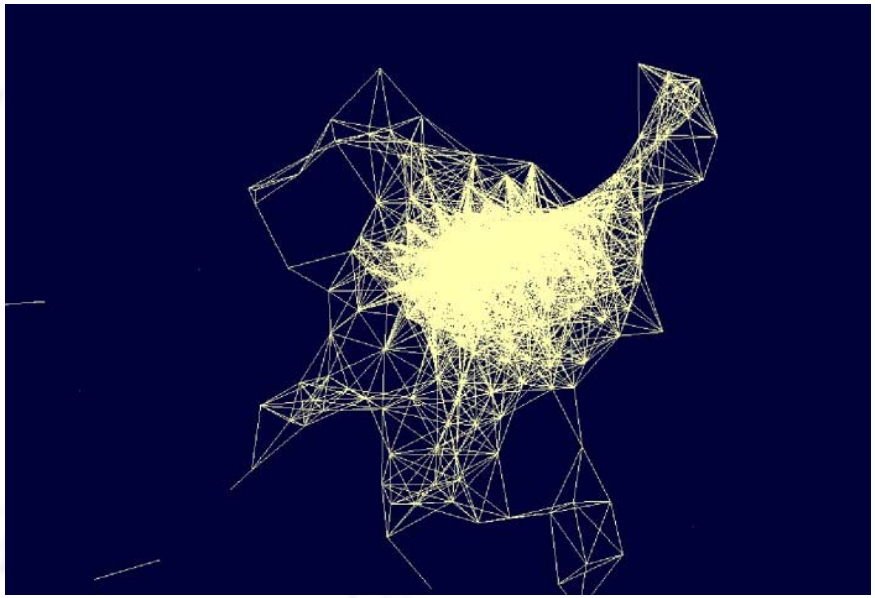
Parallel Discrete Event Simulation: Public Transportation System

The model engine that runs on the cluster feeds on-line a graphical interface to show the simulated parameters of the network. With this interface the Transit managers (or researchers) can analyze the simulated scenario and introduce new changes into the simulation boundary conditions.



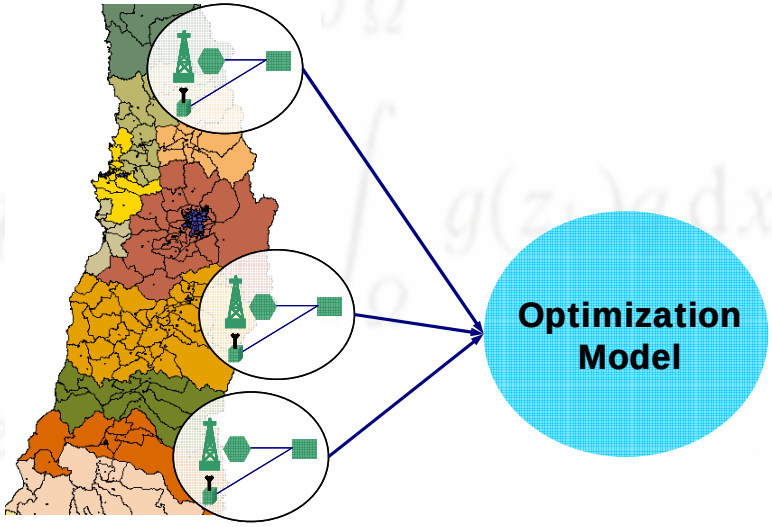
Optimization and Equilibrium in the Telecommunications Market

We have generated new models, calculation algorithms and processes for implementation and validation of efficient business models that allow the setting of rates for the services provided by landline and mobile phone companies.



Keywords

- ✓ Deregulated market models
- ✓ Mobile and fixed local phone systems
- ✓ Equilibrium/optimization problem and high performance computing

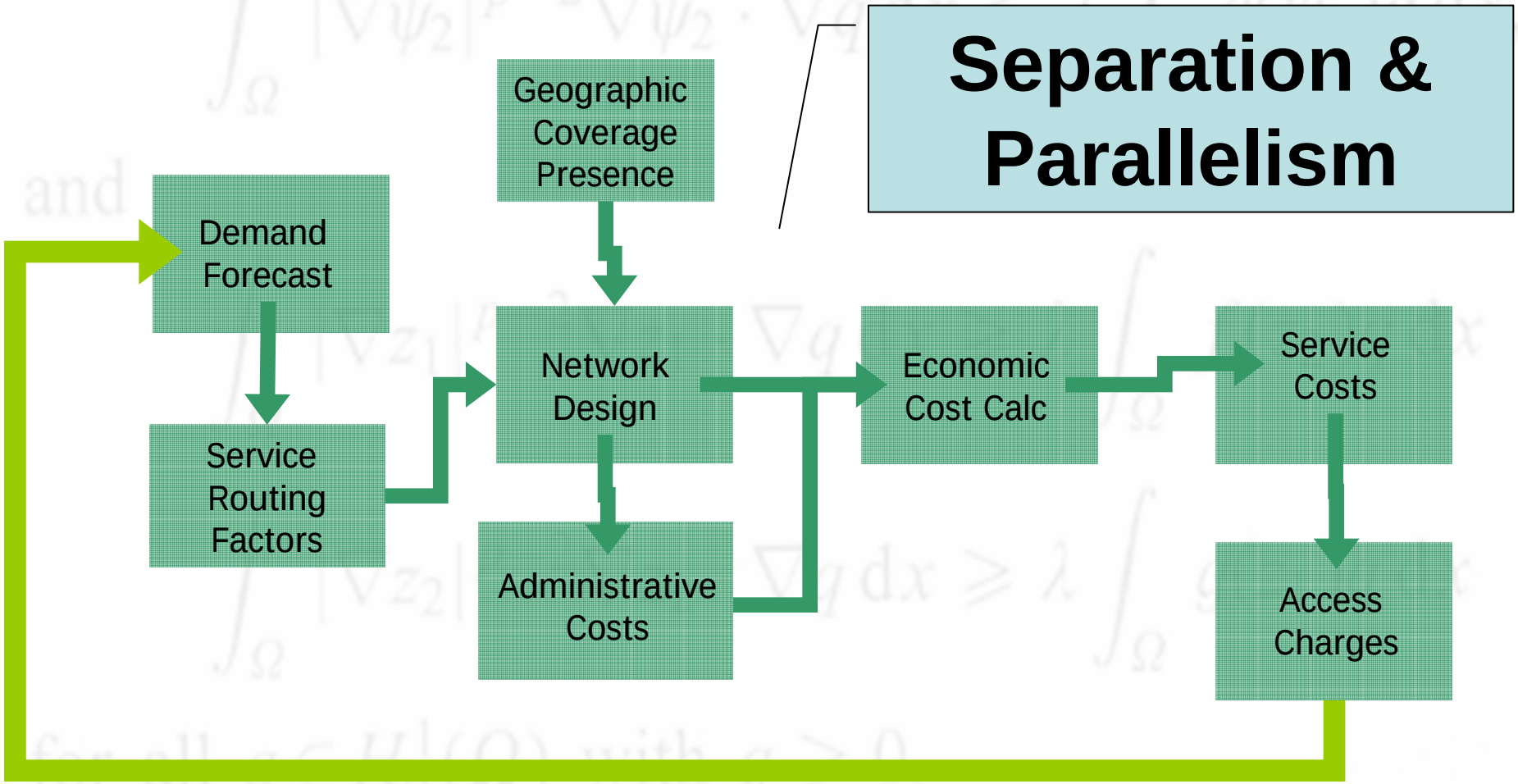


Optimization and Equilibrium in the Telecommunications Market

- **Models:**
  - LRIC (TSLRIC) cost model for Mobile and Fixed Telecommunication Networks
    - Chilean, Colombian and Peruvian Models
  - Mobile Telecommunication Networks Expansion Planning and Localization of MSC Devices Model
  - We also started to model and solve the problem of GSM BTS frequency assignment
  - Market Equilibrium Model for Mobile Telecommunications on the Access Charge Segment

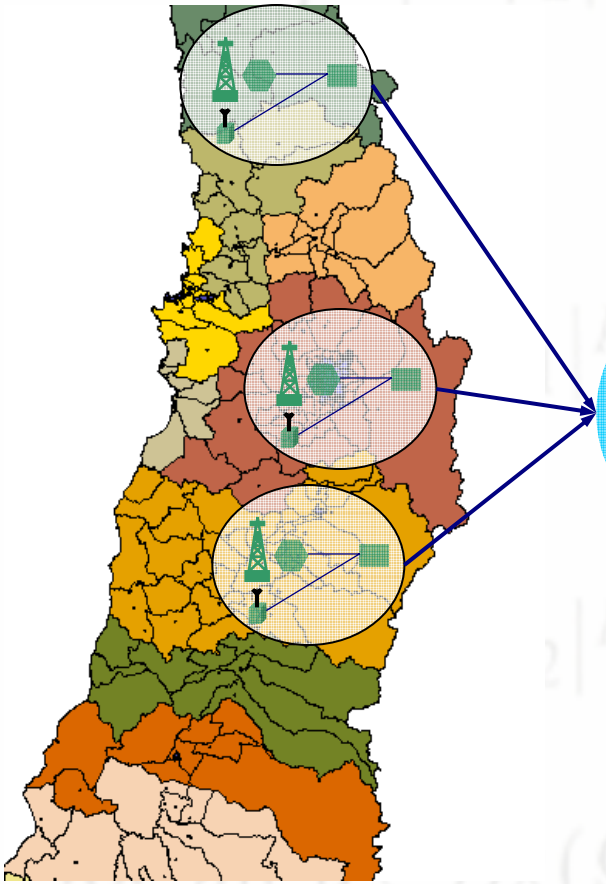
Optimization and Equilibrium in the Telecommunications Market

GENERAL MODEL FOR MOBILE ACCESS CHARGES



Equilibrium Model

Optimization and Equilibrium in the Telecommunications Market
GENERAL MODEL – MSC LOCALIZATION



Optimization Model

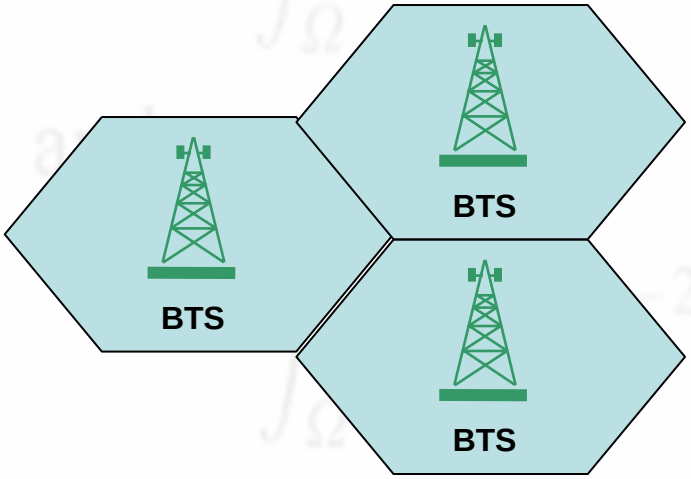
Regional Problem Separation

Number & location of MSC (**M**obile **S**witching **C**enter)

Number of BTS (**B**ase station **T**ransceiver **S**tation)
Number of BSC (**B**ase **S**tation **C**ontroller)
For each geographic zone

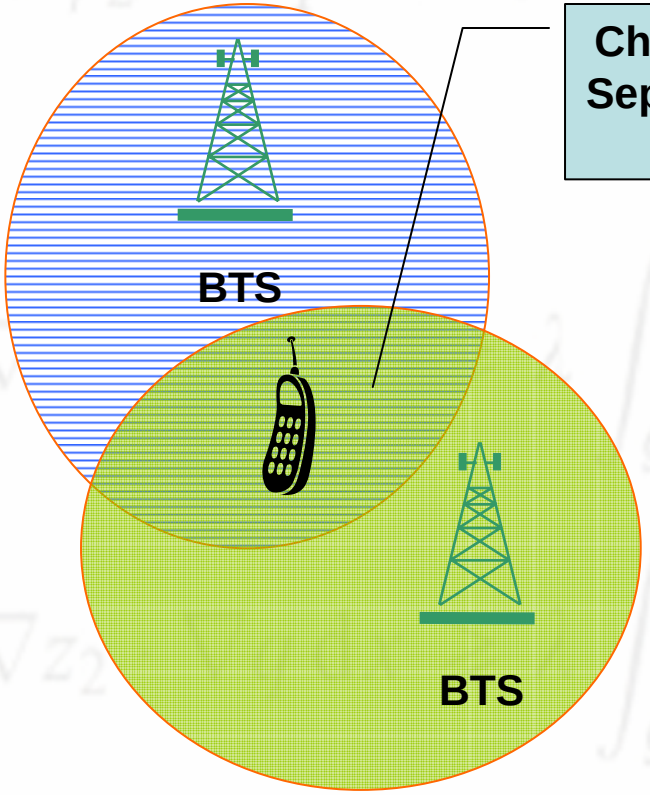
Optimization and Equilibrium in the Telecommunications Market

GENERAL MODEL – FREQUENCY ASSIGNMENT



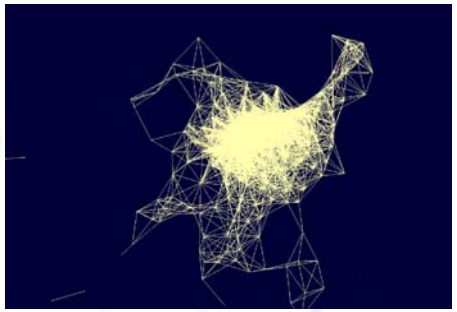
IDEAL CONFIGURATION

There is no Interference



Channel Interference Separation by District & Bands

REAL CONFIGURATION



Santiago Graph

Optimization and Equilibrium in the Energy Market

We have created new models and improved some algorithms for coordinating the use of water reservoirs in hydrothermal energy systems. Especially using Stochastic Programming. We are also working on the problem of Optimal Expansion of Electrical Power Systems.

un descompresor YUV420 codec.

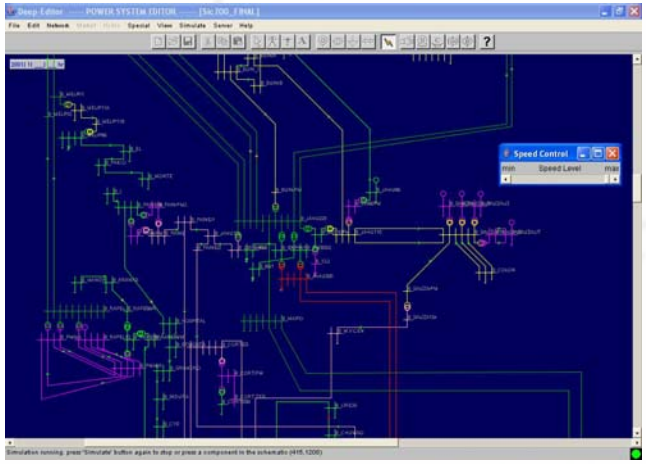
Keywords

- ✓ Energy Markets Regulation
- ✓ Hydrothermal Coordination
- ✓ Equilibrium/optimization problem and high performance computing

Optimization and Equilibrium in the Energy Market

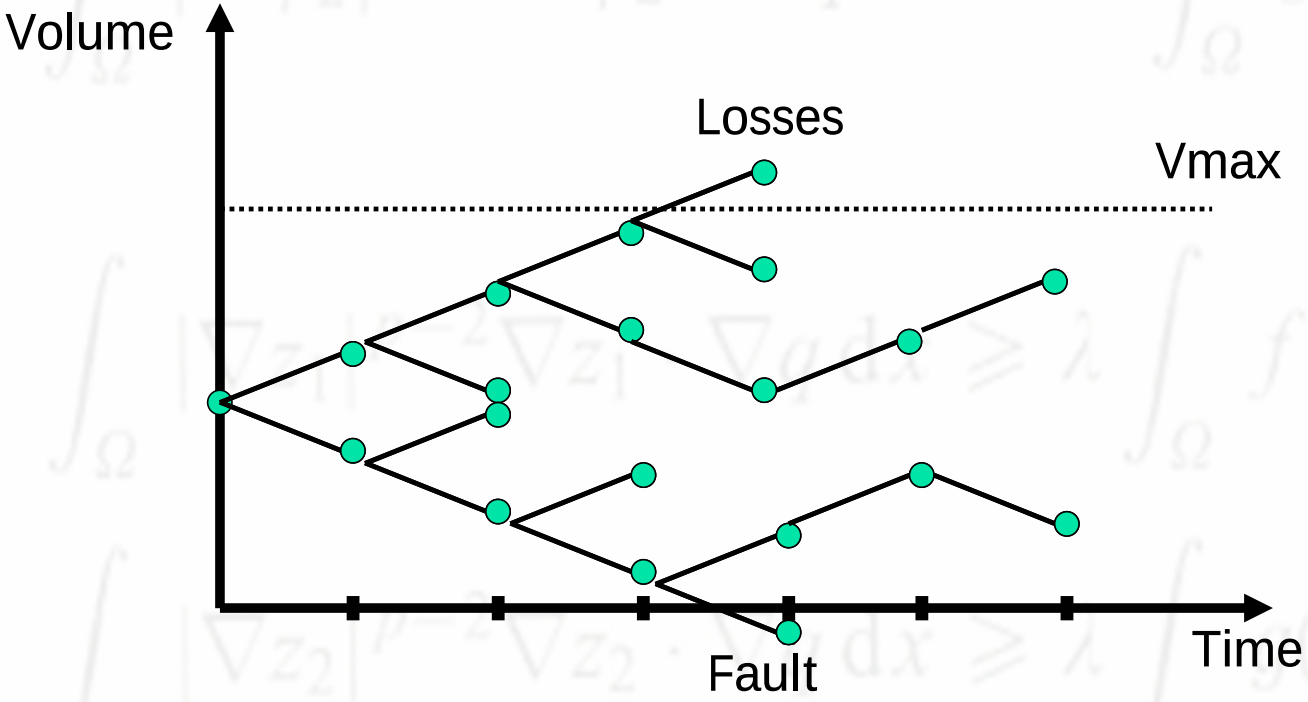
HYDROTHERMAL COORDINATION MODEL

The main objective is to establish an appropriated policy of administration and use of the water reservoirs in an electrical power system



Optimization and Equilibrium in the Energy Market

HYDROTHERMAL COORDINATION MODEL

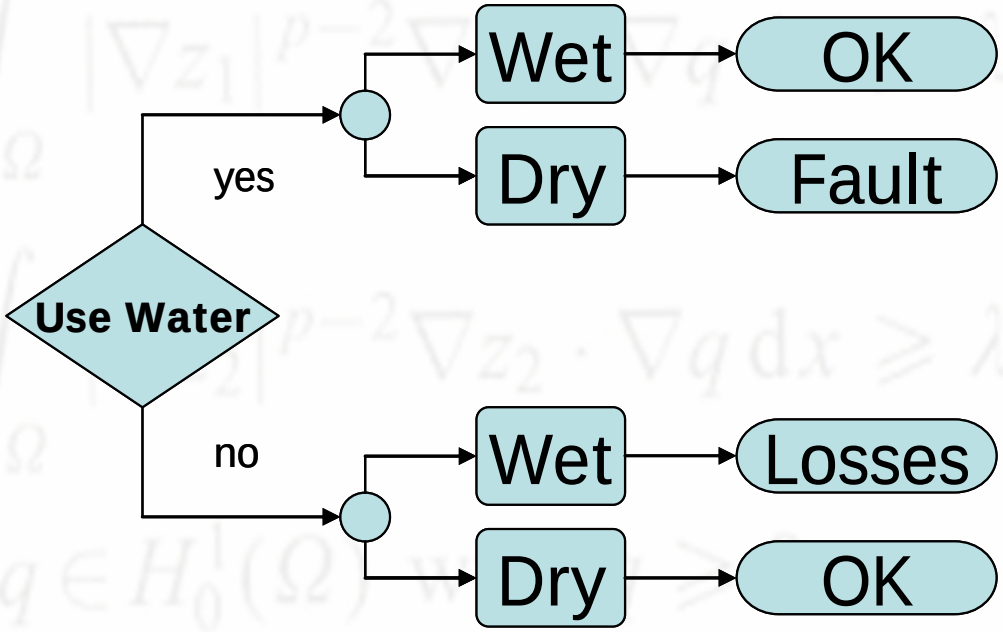


Separation on the Sampling Tree

Optimization and Equilibrium in the Energy Market

HYDROTHERMAL COORDINATION MODEL

- The problem of the high number of scenarios combinations is solved using an approximation which involves a sampling of the Scenarios Tree



Optimization and Equilibrium in the Energy Market

HYDROTHERMAL COORDINATION MODEL

- The main idea is to solve each scenario sequence as a separated problem, then we use it to turn this problem into a parallel problem